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EXAMINER	
KWON, ASHLEY M	

ART UNIT	PAPER NUMBER
1795	

NOTIFICATION DATE	DELIVERY MODE
09/04/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/560,822	OLIVIER ET AL.	
	Examiner	Art Unit	
	ASHLEY KWON	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *10-26* is/are pending in the application.

4a) Of the above claim(s) *19-26* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *10-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *10-26* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Newly submitted claims 19-26 directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The original invention of claims 10-18 and the invention of new claims 19-26 have materially different design and are not obvious variants. The original invention of claims 10-18 are directed to a fuel cell stack comprising a plurality of thermoelectric modules in thermal contact with a heat source at one end and a cold sink at the other. The invention of new claims 19-26 are directed to a fuel cell stack comprising a first thermoelectric module layer disposed between and attached to a first plate and first fuel cell, and a second thermoelectric module layer disposed between and attached to a second plate and second fuel cell. Since the original invention of claims 10-18 do not require a plurality of thermoelectric modules be in two separate layers in contact with two different fuel cells, the two inventions require materially different designs and are not obvious variants.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 19-26 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Response to Amendment

In response to the amendment received June 15, 2009:

a. Claims 10-26 are pending;

b. Claims 10-18 were amended and new claims 19-26 were added;

c. The objection to the specification is withdrawn in light of the amendment;

d. New prior art rejections have been applied to claims 10-18 in light of applicant's amendments;

e. Newly added claims 19-26 have been withdrawn due to an election restriction by original presentation.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 10-18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 10, the phrase "in facing relationship" is considered indefinite. It is unclear how two fuel cells "in facing relationship" distinguishes over two fuel cells in a normal fuel cell stack. Fuel cells in a stack are inherently "in facing relationship". Applicant is asked to further clarify. For the purposes of this rejection, any two fuel cells adjacent to each other will be considered as "in facing relationship".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

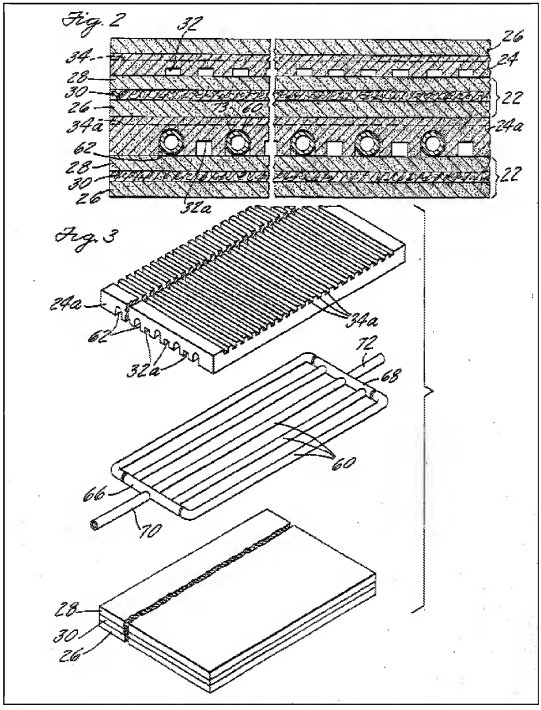
The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 10-12 and 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiser (US Pat. No. 3,964,930) in view of Fujita et al. (JP 2002-238272 A) (hereinafter "Fujita").

Regarding claim 10, Reiser teaches a fuel-cell stack (10, 12) comprising: at least two elementary cells (22; see col. 3 line 59) disposed in a facing relationship, for an exothermic combustion reaction constituting a heat source (separators; 24 and 24a), the exothermic combustion reaction includes an oxidizer and a reactant, and the reactant and oxidizer circulate within each elementary cell (see col. 3 lines 64 – col. 4, line 6), an internal duct (cooler tubes, 60) formed between the cells for circulation of a cooling fluid constituting a cold sink (see figs. 2 and 3; see col. 2, line 19-23; see col. 4, line 57-78). Baring further specification, fig. 2 of Reiser will be interpreted as depicting two

elementary cells (22) in a facing relationship with an internal duct (60) formed between the cells.



Reiser fails to teach a plurality of thermoelectric modules, each comprising a pair of elements of two conductive materials of dissimilar nature, a first end of the pair being in thermal contact with the heat source or the cold sink, a second end of the pair being in contact with the other heat source or cold sink, and being electrically connected to a neighboring thermoelectric module.

However, Fujita teaches a plurality of thermoelectric modules (p-n unit, see fig. 2), each comprising a pair of elements of two conductive materials of dissimilar nature (P-type, 1; N-type, 2; see drawing 1), a first end of each pair being in thermal contact with the heat source (plate with high- temperature exhaust gas channel; see fig. 16) or the cold sink (cooling medium, see fig. 16), a second end of each of the elements of the pair being in contact with the other source or sink (see paragraph 60; see drawing 16), and being electrically connected to a neighboring module (see paragraph 27; see drawing 2)

[Drawing 1]

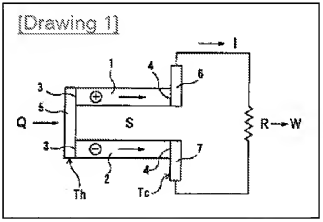


FIG. 2

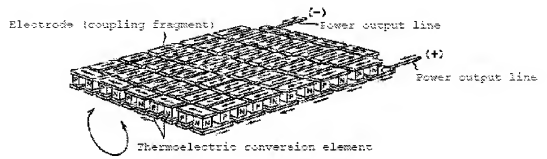
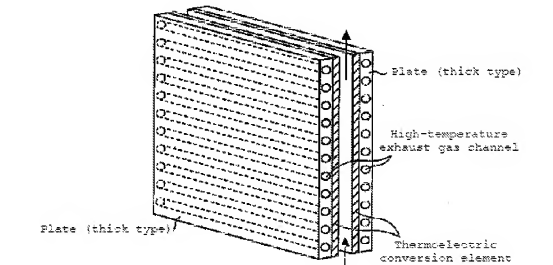


FIG. 16



The combination of familiar elements is likely to be obvious when it does no more than yield predictable results. See *KSR International Co. v. Teleflex Inc.*, 550 U.S. __,__, 82 USPQ2d 1385, 1395 – 97 (2007) (see MPEP § 2143, A.). It would have been obvious to a person of ordinary skill in the art to use the thermoelectric element taught by Fujita in fig. 16 in the fuel cell stack taught by Reiser, specifically adding a

thermoelectric conversion element in between the separator and cooler tubes so that the thermoelectric element is in thermal contact with both the separator and cooler tubes in order to generate electricity (*Fujita:* see paragraph 2).

Regarding claim 11, Reiser in view of Fujita teaches the fuel-cell stack according to claim 10, wherein the first end of the pair is connected with a conductive thermal contact with a plate of the heat source (*Reiser:* electrically conductive plate, 24a), and the second end of the pair is in a thermal contact with the cold sink (*Reiser:* cooler tubes, 60). The plates depicted in fig. 16 of Fujita are analogous to the separator plate (24a) disclosed by Resier because both serve as heat sources. Therefore the combination of Resier and Fujita would result in a first end of the pair of elements comprising the thermoelectric module in conductive thermal contact to a bipolar plate (separator, 24a) and a second end of the pair in thermal contact with the cold sink (cooler tubes, 60).

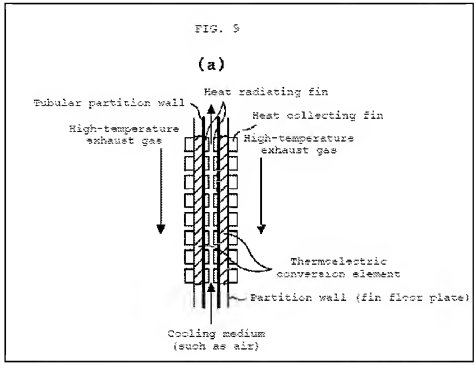
Regarding claim 12, Resier in view of Fujita teaches the fuel-cell stack according to claim 10, wherein the two conductive materials of the thermoelectrical modules are semiconductor materials, a first of P type and a second of N type (*Fujita:* see paragraph 27).

Regarding claim 15, Reiser in view of Fujita fails to teach a fuel-cell stack according to claim 10, wherein a last thermoelectric module of an assembly disposed along a first elementary cell is electrically connected in series or in parallel with a first thermoelectrical module of an assembly disposed along a second elementary cell. However, the Supreme Court decided that a claim can be proved obvious merely by

showing that the combination of known elements was obvious to try. In this regard, the Supreme Court explained that, "[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has a good reason to pursue the known options within his or her technical grasp." An obviousness determination is not the result of a rigid formula disassociated from the consideration of the facts of the case. Indeed, the common sense of those skilled in the art demonstrates why some combinations would have been obvious where others would not. Therefore, choosing from a finite number of identified, predictable solutions, with a reasonable expectation for success, is likely to be obvious to a person if ordinary skill in the art. See *KSR International Co. v. Teleflex Inc.*, 550 U.S. __,__, 82 USPQ2d 1385, 1395 – 97 (2007) (see MPEP § 2143, E.). It is well known in the art that fuel cells may be connected in series or in parallel to increase either the current or the voltage of the fuel cell system. Since the goal of this device is to produce electricity, it would have been obvious to a person of ordinary skill in the art that the thermoelectric modules of different fuel cells be connected in series or in parallel to increase either the current or the voltage of the electricity produced.

Regarding claim 16, Reiser in view of Fujita teaches a fuel-cell stack according to claim 10, wherein a plate forming a wall equipped with fins (radiation fins) is disposed on the external surface of the assembly of thermoelectric modules on the same side as the internal cooling duct (*Fujita:* see paragraph 52, see fig 9a). It would have been obvious to one of ordinary skill in the art that the embodiment depicted by fig. 16 would also contain heat radiating fins in order to effectively transmit the cooling of the cooling

medium to the low-temperature side of the thermoelectric conversion element (*Fujita:* see paragraph 52).



Claims 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Reiser in view of Fujita as applied to claims 10-12 and 15-16 above, and further in view of Ghamaty et al. (US Pat. No. 6,096,964) (hereinafter "Ghamaty") .

Regarding claim 13, Reiser in view of Fujita fail to teach th fuel-cell stack according to claim 12, wherein the N-type materials are alloys of silicon and germanium doped with phosphorus and the P-type materials are alloys of silicon and germanium doped with boron.

However, Ghamaty teaches thermoelectric elements, N and P-type samples consisting of silicon and germanium alloys, with the N-type doped with phosphorous

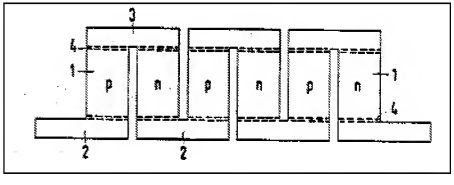
and the P-type doped with boron (see col. 4, lines 18-20; col. 4, lines 40-41). Ghamaty teaches that a good thermoelectric material is measured by its "figure of merit", or Z, defined as: $Z = S^2 / \rho K$, where S is the Seebeck coefficient, ρ is the electrical resistivity, and K is the thermal conductivity. Good thermoelectric materials have large values of S and low values of ρ and K, which results in a high Z value as well (see col. 1, lines 15-30). The selection of a known material, which is based upon its suitability for the intended use, is within the ambit of one of ordinary skill in the art. See *In re Leshin*, 125 USPQ 416 (CCPA 1960) (see MPEP § 2144.07). A person of ordinary skill in the art would have found it obvious to use N-type materials that are alloys of silicon and germanium doped with phosphorus and P-type materials that are alloys of silicon and germanium doped with boron since silicon germanium alloys are well known to have high Z values, in order to improve the thermoelectric materials (see col. 4, lines 49-50).

Claims 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Reiser in view of Fujita as applied to claims 10-12 and 15-16 above, and further in view of Szabo de Bucs et al. (US Pat No. 3,470,033) (hereinafter "Szabo de Bucs") .

Regarding claim 14, Reiser in view of Fujita fail to teach the fuel-cell stack according to claim 10, wherein the conductive connections connecting the ends of the materials are composed of molybdenum electrodes.

However, Szabo de Bucs teaches a thermoelectric device whose legs are interconnected by contact bridges (2, 3) composed of an alloy of silicon with molybdenum (see col. 4, lines 57-61; see the figure). The selection of a known

material, which is based upon its suitability for the intended use, is within the ambit of one of ordinary skill in the art. See *In re Leshin*, 125 USPQ 416 (CCPA 1960) (see MPEP § 2144.07). A person of ordinary skill in the art would have found it obvious to use molybdenum in the conductive connections connecting the ends of the N and P-type materials because the metallic component provided by molybdenum contributes to securing a particularly high mechanical strength, high resistance to breaking, and high stability with respect to changes in temperature to the contacting bond (*Szabo de Bucs:* see col. 3, lines 18-22).



Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiser in view of Fujita.

Regarding claim 17, Reiser teaches a fuel cell stack producing a first electrical energy and a heat energy from the fuel cell stack (see col. 1, lines 9-18); circulating a cooling fluid in an interior (cooler tubes, 60; see col. 4, lines 54-60) between two elementary cells (22).

Reiser fails to teach a method for partial recuperation of thermal energy originating from a fuel-cell stack, comprising: a cooling fluid in thermal contact with a

first side of a plurality of thermoelectric modules attached to the fuel-stack cell; heating a second side of the plurality of the thermoelectrical modules with the heat energy; and generating a second electrical energy by a Seebeck effect.

However, Fujita teaches a method for partial recuperation of thermal energy originating from a fuel cell stack (see paragraph 3), where a cooling fluid in thermal contact with a first side of a plurality of thermoelectric modules (p-n unit) (*Fujita*: see paragraph 52; see drawing 16); heating a second side of the plurality of the thermoelectrical modules with the heat energy (plate with high-temperature exhaust gas channel, see fig. 16); and generating a second electrical energy by a Seebeck effect (see paragraph 3). The combination of familiar elements is likely to be obvious when it does no more than yield predictable results. See *KSR International Co. v. Teleflex Inc.*, 550 U.S. __,__, 82 USPQ2d 1385, 1395 – 97 (2007) (see MPEP § 2143, A.). It would have been obvious to a person of ordinary skill in the art to use a method for partial recuperation of thermal energy by the thermoelectric element taught by Fujita in drawing 16, in the fuel cell stack taught by Reiser, specifically adding a thermoelectric conversion element in between the separator and cooler tubes so that the thermoelectric element is in thermal contact with both the separator and cooler tubes in order to generate electricity by the Seebeck effect (*Fujita:* see paragraph 2).

Regarding claim 18, Reiser in view of Fujita teaches a method according to claim 17, wherein cooling of the cell stack is two-phase (*Reiser:* see col. 6, lines 3-6).

Response to Arguments

Applicant's arguments with respect to claims 10-18 have been considered but are moot in view of the new ground(s) of rejection.

Applicant argues:

"...it is respectfully submitted that Reiser does not disclose or suggest "[a] fuel-cell stack, comprising: at least two elementary cells in facing relationship, [a] reactant and the oxidizer circulate within each elementary cell; [and] an internal duct formed between the cells," as recited in Claim 10..... As the functions of adjacent fuel-cells in a stack as discussed by Reiser are intertwined at a separator plate, then the adjacent fuel-cells cannot be in a facing relationship."

However, as argued above for claim 10, the phrase "in facing relationship" is considered indefinite. Barring further specification, Reiser's disclosure of two adjacent fuel cells is enough to meet the limitation. Furthermore, the use of a bipolar plate to provide reactant and oxidizer to two adjacent fuel cells is well known in the art and does not preclude the adjacent fuel cells from being in a facing relationship.

Applicant argues:

"..... assuming arguendo that a "fuel-cell" is defined merely as the anode 28, the cathode 26, and the electrode retaining matrix 30, then Reiser does not discusses the reactant and the oxidizer circulating within each elementary cell because the channels 32, 32a, 34, 34a are outside the "fuel-cell.""

However, it is well known in the art that a "fuel cell" not only comprises an anode, cathode, and electrode retaining matrix, but corresponding separator and bipolar plates as well. Therefore Reiser does disclose the reactant and oxidizer circulating within the fuel cell (see col. 3 line 64 – co. 4 line 6). The invention would be unable to generate electricity if reactant and oxidizer were not circulating within the fuel cells.

Applicant argues:

"Applicants disagree and respectfully point out that when the thermoelectric element of Fuiita is added to the outside heat exchanger of Reiser, then it does not result in the thermoelectric module in conductive thermal contact with a bipolar plate of the heat source because then the thermoelectric module would be in convective thermal contact with a fuel-cell."

However, as explained above for claim 11, Fujita does not limit his invention to only a heat exchanger outside the fuel cell. For the purposes of this rejection, the separator plate (24a) taught by Reiser and plate containing high-temperature exhaust gas channel (see fig. 16) taught by Fujita are considered analogous because both serve as heat sources. Therefore, the combination would necessarily result in the thermoelectric module taught by Fujita to be in conductive thermal contact with the separator (24a) taught by Reiser.

Applicant argues that both Ghamaty and Szabo de Bucs fails to disclose or suggest a plurality of thermoelectric modules in conductive thermal connection with a fuel cell. However, neither of these references are used to teach the plurality of thermoelectric modules in conductive thermal connection with a fuel cell, therefore this argument is moot. Ghamaty is used to teach the the P and N-type materials, and Szabo de Bucs is used to teach the composition of the conductive connections connecting the ends of elements of the themoelectric elements.

The arguments made regarding claims 19-26 are not considered since these claims have been withdrawn due to an election restriction by original presentation.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ASHLEY KWON whose telephone number is (571)270-7865. The examiner can normally be reached on Monday to Thursday 7:30 - 6 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ASHLEY KWON/
Examiner, Art Unit 1795

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Supervisory Patent Examiner, Art Unit 1795